Amendments to the Claims

1-25. (Cancelled)

26. (New) A method of nondestructive analysis of a test object, comprising:

a) activating a camera to capture an image of a test object, and transmitting said image to a memory of a computer,

b) altering an optical field captured by the camera, after the camera has completed step (a) but before the camera has acquired any further image,

c) re-activating the camera to capture another image of the test object, and transmitting said another image to the memory of the computer,

d) deforming the object,

e) repeating steps (a) through (c) while the object is deformed,

f) calculating an optical phase for each portion of each image, and

g) displaying a pattern representative of differences between optical phases of each image.

27. (New) The method of Claim 26, wherein steps (a) through (c) are performed for a plurality of times.

28. (New) The method of Claim 27, wherein steps (a) through (c) are repeated for a plurality of times while the object is undeformed and while the object is deformed.

29. (New) The method of Claim 28, wherein steps (a) through (c) are repeated four times while the object is undeformed and four times while the

object is deformed, and wherein step (f) includes calculating a phase for each pixel of a final image, according to the following equation:

$$\Delta(x,y) = \tan^{-1}\left[\frac{I_8(x,y) - I_6(x,y)}{I_5(x,y) - I_7(x,y)}\right] - \tan^{-1}\left[\frac{I_4(x,y) - I_2(x,y)}{I_1(x,y) - I_3(x,y)}\right].$$

where I_1 through I_8 are eight captured images given by:

$$I_1(x,y) = I'(x,y) + I''(x,y)\cos[\phi(x,y)],$$
$$I_2(x,y) = I'(x,y) + I''(x,y)\cos[\phi(x,y) + \pi/2],$$
$$I_3(x,y) = I'(x,y) + I''(x,y)\cos[\phi(x,y) + \pi],$$
$$I_4(x,y) = I'(x,y) + I''(x,y)\cos[\phi(x,y) + 3\pi/2],$$
$$I_5(x,y) = I'(x,y) + I''(x,y)\cos[\phi(x,y) + \Delta(x,y)],$$
$$I_6(x,y) = I'(x,y) + I''(x,y)\cos[\phi(x,y) + \Delta(x,y) + \pi/2],$$
$$I_7(x,y) = I'(x,y) + I''(x,y)\cos[\phi(x,y) + \Delta(x,y) + \pi],$$
$$I_8(x,y) = I'(x,y) + I''(x,y)\cos[\phi(x,y) + \Delta(x,y) + 3\pi/2]$$

wherein I' is a bias intensity, I'' is a modulation intensity, ϕ is a random phase variable due to diffuse reflection of light from the object, and Δ is a quantity directly proportional to differential displacement due to deformation.

30. (New) The method of Claim 29, wherein the first equation of Claim 29 is evaluated with a lookup table having pre-stored values for an arctangent function.

31. (New) The method of Claim 30, further comprising the step of applying a nonlinear smoothing technique to the calculated phases.

32. (New) The method of Claim 26, wherein the camera includes a shearography head comprising at least one translatable mirror, and wherein step (b) is performed by activating a piezoceramic disk connected to said mirror, wherein movement of the mirror causes a change in an image captured by the camera.

33. (New) The method of Claim 27, wherein the camera includes a shearography head comprising at least one translatable mirror, and wherein step (b) is performed by activating a piezoceramic disk connected to said mirror, wherein movement of the mirror causes a change in an image captured by the camera.

34. (New) The method of Claim 28, wherein the camera includes a shearography head comprising at least one translatable mirror, and wherein step (b) is performed by activating a piezoceramic disk connected to said mirror, wherein movement of the mirror causes a change in an image captured by the camera.

35. (New) The method of Claim 29, wherein the camera includes a shearography head comprising at least one translatable mirror, and wherein step (b) is performed by activating a piezoceramic disk connected to said mirror, wherein movement of the mirror causes a change in an image captured by the camera.

36. (New) A method of nondestructive analysis of a test object, comprising:

a) activating a camera to capture an image of a test object, and

transmitting said image to a memory of a computer,

b) altering an optical field captured by the camera, after the camera has completed step (a) but before the camera has acquired any further image,

c) re-activating the camera to capture another image of the test object, and transmitting said another image to the memory of the computer,

d) deforming the object,

e) repeating steps (a) through (c) while the object is deformed,

f) calculating an optical phase for each portion of each image, and

g) displaying a pattern representative of differences between optical phases of each image,

wherein wherein step (f) includes calculating a phase for each pixel of a final image, wherein the phases are calculated with a lookup table having pre-stored values,

wherein step (f) further comprises applying a nonlinear smoothing technique to the calculated phases,

wherein the evaluation using the lookup table and the application of the smoothing technique are performed between acquisition of successive images.

37. (New) A method of nondestructive testing, comprising:

a) stepping a shearography camera through a plurality of video frames, each frame comprising an image of a test object, and storing each video frame,

b) repeating step (a) while the test object is deformed, and

c) generating a pattern representative of phase differences caused by deformation of the object,

wherein the camera is stepped between successive video frames.

38. (New) The method of Claim 37, wherein the shearography camera includes a Michelson interferometer having at least one movable mirror, and wherein step (a) comprises moving said mirror through a predetermined distance.

39. (New) The method of Claim 38, wherein the mirror is connected to a piezoceramic disk, and wherein step (a) comprises transmitting an electrical signal to said disk so as to cause movement of the mirror.

40. (New) The method of Claim 37, wherein step (c) includes calculating phases of each portion of each video frame, the calculating being performed by reference to a lookup table and also using a nonlinear smoothing technique, wherein the calculation of phases and application of the smoothing technique are performed between successive video frames.

41. (New) A portable real-time high-resolution digital phase-stepped shearography apparatus comprising:

a) a shearography head including at least one movable mirror and a piezoceramic disk connected to the mirror,

b) a programmed computer connected to said shearography head, and

c) a display, connected to the computer,

wherein the computer is programmed to issue signals to the piezoceramic disk so as to control movements of the mirror, and wherein the computer is programmed to store images of a test object captured by the shearography head, and to analyze said images so as to produce a pattern viewable on the display.

42. (New) The shearography apparatus of Claim 41, wherein the computer comprises means for moving the mirror between successive video frames.

43. (New) The shearography apparatus of Claim 42, wherein the computer is programmed to analyze said images while the mirror is not moving, wherein the images are analyzed in real time.

44. (New) The shearography apparatus of Claim 41, wherein the shearography head is mounted in an enclosure, and wherein the enclosure also includes an excitation mechanism for causing deformation of a test object.

45. (New) The shearography apparatus of Claim 42, wherein the shearography head is mounted in an enclosure, and wherein the enclosure also includes at least one excitation mechanism for causing deformation of a test object.

46. (New) The shearography apparatus of Claim 45, wherein the computer is programmed to analyze said images while the mirror is not moving, wherein the images are analyzed in real time.

47. (New) The shearography apparatus of Claim 41, wherein the shearography head includes a high-resolution video camera.

48. (New) A portable real-time high-resolution digital phase-stepped shearography apparatus comprising:

a) a shearography head including a high-resolution video camera and a Michelson interferometer including at least one movable mirror and a piezoceramic disk connected to the mirror,

b) the shearography head being connected to a housing, wherein the housing supports at least one excitation mechanism,

c) a programmed computer connected to said shearography head, and

d) a display, connected to the computer,

wherein the computer is programmed to issue signals to the piezoceramic disk so as to control movements of the mirror, and wherein the computer is programmed to store images of a test object captured by the shearography head, and to analyze said images so as to produce a pattern viewable on the display.

49. (New) The shearography apparatus of Claim 48, wherein the computer comprises means for moving the mirror between successive video frames.

50. (New) The shearography apparatus of Claim 48, wherein the housing comprises an enclosure having a top, the shearography head being mounted on the top of the enclosure, the enclosure including at least one mirror and a window.

51. (New) The shearography apparatus of Claim 50, wherein the enclosure has a hole which cooperates with a second hole in the shearography head, wherein light can pass from the head, to the object, and back into the head.

52. (New) A method of nondestructive testing of an object, comprising:

a) aiming a portable shearography unit at a test object, the shearography unit including a shearography head, and at least one excitation mechanism, the shearography unit being connected to a computer and a display,

b) activating the shearography head to acquire images of the test object while the object is in an undeformed state,

c) actuating the excitation mechanism so as to deform the object,

d) activating the shearography head to acquire images of the test object while the object is in a deformed state,

e) processing the images acquired in steps (b) and (d) in the computer so as to generate a pattern on the display.

53. (New) The method of Claim 52, wherein steps (b) and (d) include stepping the shearography head through a plurality of distinct optical fields, and wherein the stepping is performed between successive images.

54. (New) The method of Claim 53, wherein the stepping is performed by transmitting signals to a piezoceramic disk connected to a mirror in the shearography head so as to move the mirror through a predetermined distance.

55. (New) A portable real-time high-resolution digital phase-stepped shearography apparatus comprising:

a) a shearography head including at least one movable mirror and a piezoceramic disk connected to the mirror,

b) a programmed computer connected to said shearography head, and

c) a display, connected to the computer,

wherein the computer is programmed to issue signals to the piezo-ceramic disk so as to control movements of the mirror, and wherein the computer is programmed to store images of a test object captured by the shearography head, and to analyze said images so as to produce a pattern viewable on the display,

wherein the computer comprises means for moving the mirror between successive video frames,

wherein the computer is programmed to analyze said images while the mirror is not moving, wherein the images are analyzed in real time,

wherein the computer comprises means for calculating an optical phase for each portion of each image,

wherein the computer includes means for calculating optical phases using a lookup table having pre-stored values,

and wherein the computer further comprises means for applying a non-linear smoothing technique to the calculated phases.

56. (New) A portable real-time high-resolution digital phase-stepped shearography apparatus comprising:

a) a shearography head including at least one movable mirror and a high-resolution camera,

b) a programmed computer connected to said shearography head, and

c) a display, connected to the computer,

wherein the computer is programmed to issue signals to control movements of the mirror, and wherein the computer is programmed to store images of a test object captured by the shearography head, and to analyze said

images so as to produce a pattern viewable on the display,

wherein the computer comprises means for moving the mirror between successive video frames,

wherein the computer is programmed to analyze said images while the mirror is not moving, wherein the images are analyzed in real time,

wherein the computer comprises means for calculating an optical phase for each portion of each image,

wherein the computer includes means for calculating optical phases using a lookup table having pre-stored values,

wherein the computer further comprises means for applying a nonlinear smoothing technique to the calculated phases,

and wherein the computer includes means for calculating said optical phases and applying the smoothing technique when the mirror is not moving, such that the evaluation and smoothing are performed in real time.

57. (New) The apparatus of Claim 56, wherein the shearography head is connected to a housing, and wherein the housing supports at least one excitation mechanism.

58. (New) The shearography apparatus of Claim 57, wherein the housing comprises an enclosure having a top, the shearography head being mounted on the top of the enclosure, the enclosure including at least one mirror and a window.